strate fixedly secured to end caps oppositely engaging the substrate, in accordance with a preferred embodiment of the invention;

[0018] FIG. **8** is a cross-section of an actively controlled texturing system including a foldable structure defining surface facets, a substrate adhered to the structure, a shape memory wire actuator external to the substrate, and end caps oppositely engaging the substrate, in accordance with a preferred embodiment of the invention;

[0019] FIG. **9** is a cross-section of an actively controlled texturing system including a foldable structure defining surface facets, a substrate adhered to the structure, and an active material sheet disposed beneath the substrate, in accordance with a preferred embodiment of the invention; and

[0020] FIG. **10** is a partial plan view of an actively controlled texturing system including a substrate, overlapping rigid members embedded therein, and shape memory arcuate actuators drivenly coupled to the members, in accordance with a preferred embodiment of the invention.

DETAILED DESCRIPTION OF THE INVENTION

[0021] The following description of the preferred embodiments is merely exemplary in nature and is not intended to limit the invention, its application, or uses. As described and illustrated herein, a novel system **10** for and method of selectively and reversibly modifying the texture of a surface **12** utilizing a variably foldable structure **14** and active material actuation is presented herein (FIGS. **1-10**). The inventive system **10** may be used to effect an intended condition, or modify a physical interaction, characteristic, or phenomenon of the surface **12** over a wide range of applications. In FIG. **1**, for example, the system **10** is shown in an automotive setting, wherein the texture of the dashboard **100** has been modified to reduce veiling glare and the texture of the center console **102** has been modified to reduce the contact surface area of engagement with a hot surface. In other applications, it is appreciated that modification of surface texture may be used to mitigate acoustic noise, or change specularity without affecting the reflectivity of the base material. In yet another application, it is appreciated that modifying external body surface textures may be used to reduce wind drag and/or produce radar scatter in automotive and aeronautical applications. Plural embodiments and examples of the system **10** are further described below.

[0022] I. Active Material Description and Discussion

[0023] As used herein the term "active material" is defined as any material or composite that exhibits a reversible change in fundamental (i.e., chemical or intrinsic physical) property when exposed to or occluded from an activation signal. In the present invention, active materials may be used to effect reconfiguration of the foldable structure **14**, and may compose an actuator **16**, and/or the structure **14** itself.

[0024] Suitable active materials for use with the present invention include but are not limited to shape memory materials that have the ability to remember at least one attribute such as shape, and this attribute can subsequently be recalled by applying an external stimulus. Exemplary shape memory materials include shape memory alloys (SMA), shape memory ceramics, electroactive polymers (EAP), ferromagnetic SMA's, electrorheological (ER) compositions, magnetorheological (MR) compositions, dielectric elastomers, ionic polymer metal composites (IPMC), piezoelectric polymers/ceramics, and high-volume paraffin wax. Among these, SMA's and EAP's in appropriate geometric form are particularly suited for use as actuators **16** herein, and, as such, are further described bellow.

[0025] Shape memory alloys (SMA's) generally refer to a group of metallic materials that demonstrate the ability to return to some previously defined shape or size when subjected to an appropriate thermal stimulus. Shape memory alloys are capable of undergoing phase transitions in which their yield strength, stiffness, dimension and/or shape are altered as a function of temperature. Generally, in the low temperature, or Martensite phase, shape memory alloys can be plastically deformed and upon exposure to some higher temperature will transform to an Austenite phase, or parent phase, returning to their shape prior to the deformation.

[0026] Shape memory alloys exist in several different temperature-dependent phases. The most commonly utilized of these phases are Martensite and Austenite phases. In the following discussion, the Martensite phase generally refers to the more deformable, lower temperature phase whereas the Austenite phase generally refers to the more rigid, higher temperature phase. When the shape memory alloy is in the Martensite phase and is heated, it begins to change into the Austenite phase. The temperature at which this phenomenon starts is often referred to as Austenite start temperature (A_s). The temperature at which this phenomenon is complete is called the Austenite finish temperature (A_f).

[0027] When the shape memory alloy is in the Austenite phase and is cooled, it begins to change into the Martensite phase, and the temperature at which this phenomenon starts is referred to as the Martensite start temperature (M_s). The temperature at which Austenite finishes transforming to Martensite is called the Martensite finish temperature (M_f). Generally, the shape memory alloys are softer and more easily deformable in their Martensite phase and are harder, stiffer, and/or more rigid in the Austenite phase. In view of the foregoing, a suitable activation signal for use with shape memory alloys is a thermal activation signal having a magnitude sufficient to cause transformations between the Martensite and Austenite phases.

[0028] Shape memory alloys can exhibit a one-way shape memory effect, an intrinsic two-way effect, or an extrinsic two-way shape memory effect depending on the alloy composition and processing history. Annealed shape memory alloys typically only exhibit the one-way shape memory effect. Sufficient heating subsequent to low-temperature deformation of the shape memory material will induce the Martensite to Austenite type transition, and the material will recover the original, annealed shape. Hence, one-way shape memory effects are only observed upon heating. Active materials comprising shape memory alloy compositions that exhibit one-way memory effects do not automatically reform, and require an external mechanical force to return the shape to its previous configuration.

[0029] Intrinsic and extrinsic two-way shape memory materials are characterized by a shape transition both upon heating from the Martensite phase to the Austenite phase, as well as an additional shape transition upon cooling from the Austenite phase back to the Martensite phase. Active materials that exhibit an intrinsic shape memory effect are fabricated from a shape memory alloy composition that will cause the active materials to automatically reform themselves as a result of the above noted phase transformations. Intrinsic two-way shape memory behavior must be induced in the shape memory material through processing. Such procedures